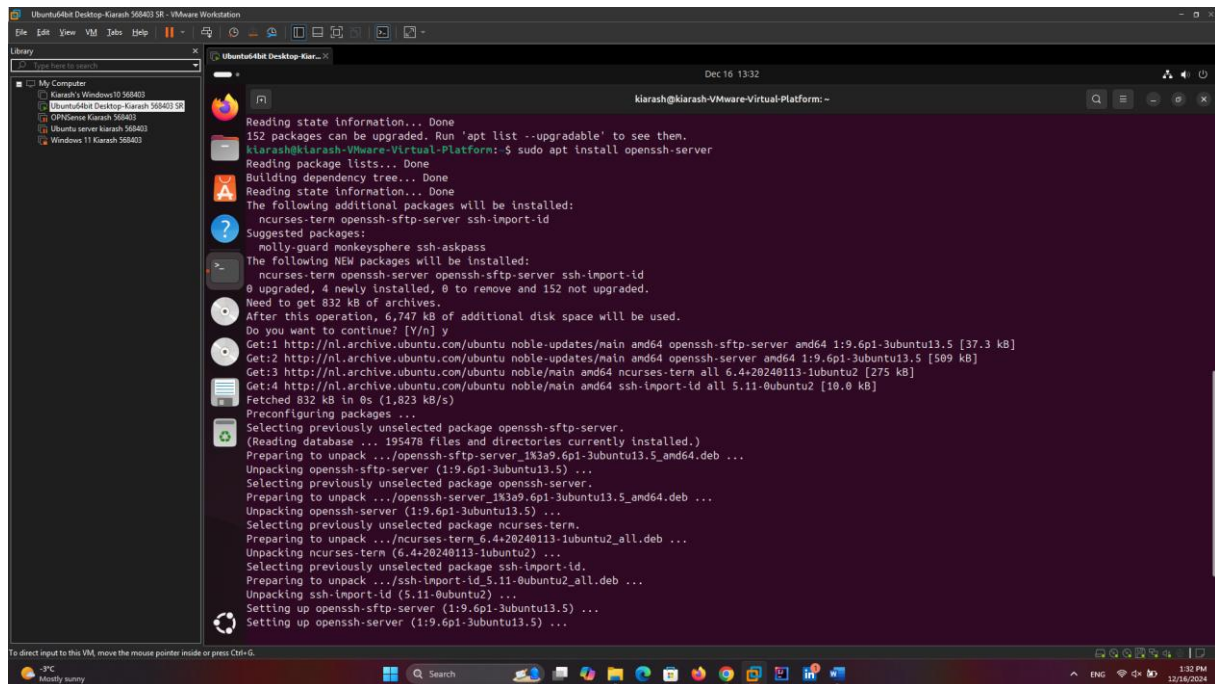


# Template Week 6 – Networking

Student number: Kiarash Delavar-568403

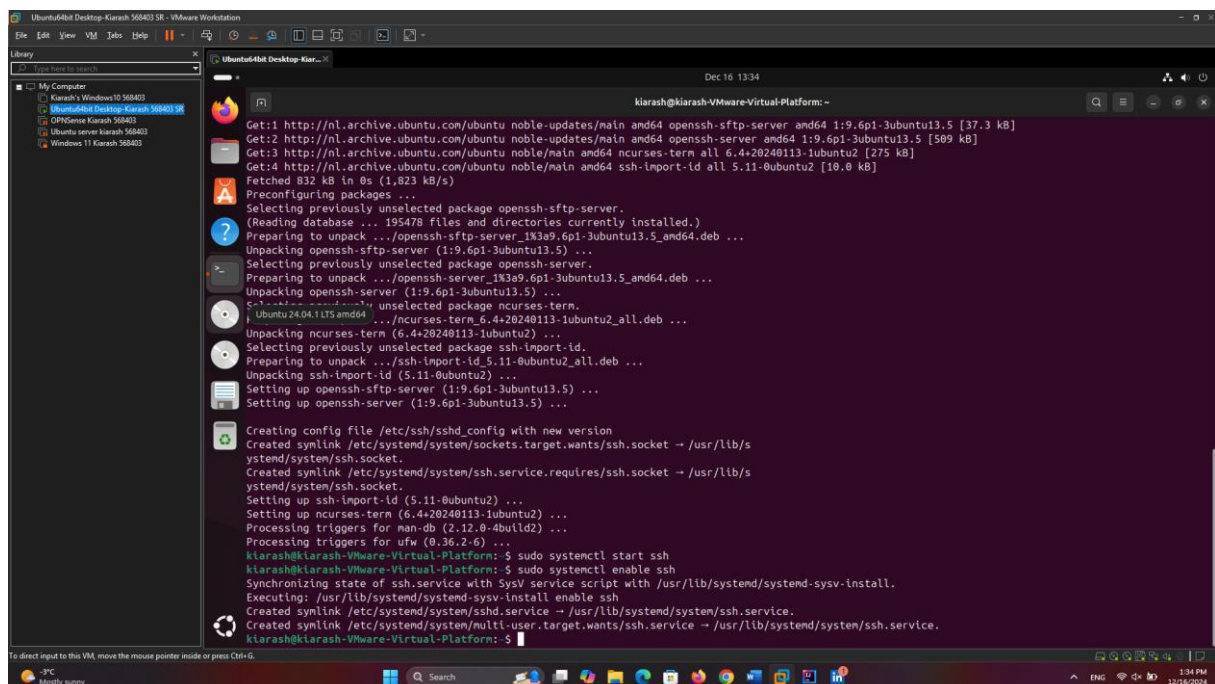
## Assignment 6.1: Working from home

### Screenshot installation openssh-server:

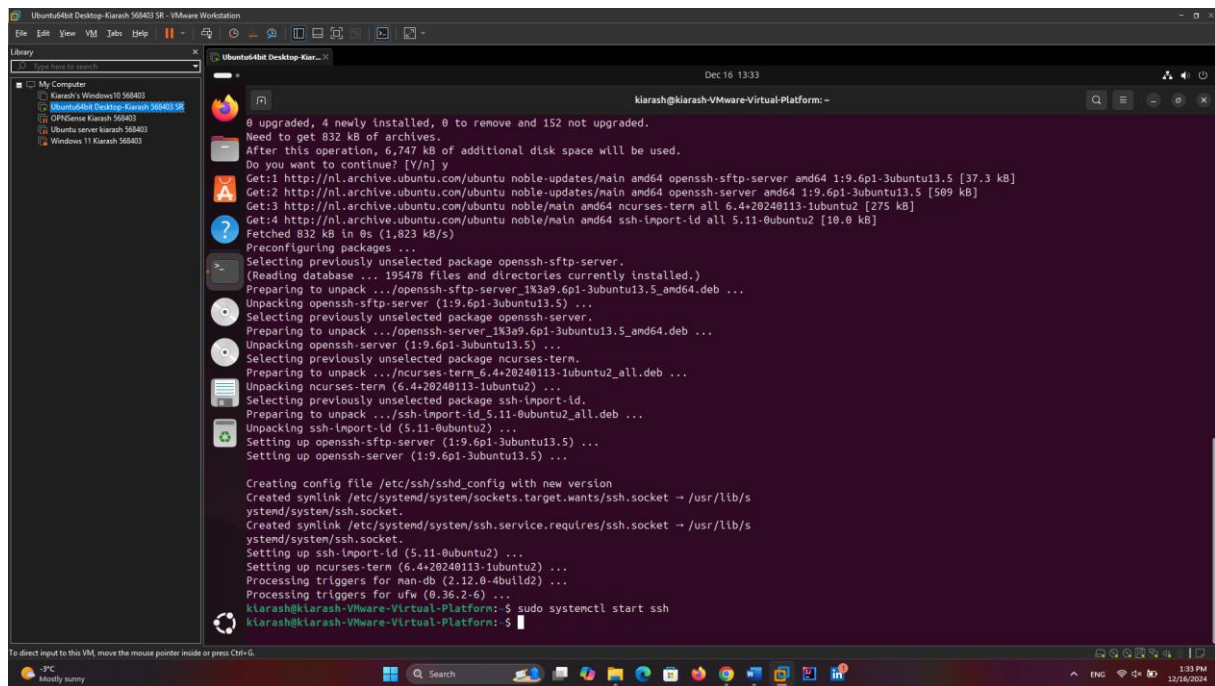


```
Reading state information... Done
152 packages can be upgraded. Run 'apt list --upgradable' to see them.
kiarash@kiarash-VMware-Virtual-Platform: ~$ sudo apt install openssh-server
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
The following additional packages will be installed:
  ncurses-term openssh-sftp-server ssh-import-id
Suggested packages:
  molly-guard monkeysphere ssh-askpass
The following NEW packages will be installed:
  ncurses-term openssh-server openssh-sftp-server ssh-import-id
0 upgraded, 4 newly installed, 0 to remove and 152 not upgraded.
Need to get 832 kB of archives.
After this operation, 6,747 kB of additional disk space will be used.
Do you want to continue? [Y/n] y
Get:1 http://nl.archive.ubuntu.com/ubuntu noble-updates/main amd64 openssh-sftp-server amd64 1:9.6p1-3ubuntu13.5 [37.3 kB]
Get:2 http://nl.archive.ubuntu.com/ubuntu noble-updates/main amd64 openssh-server amd64 1:9.6p1-3ubuntu13.5 [509 kB]
Get:3 http://nl.archive.ubuntu.com/ubuntu noble/main amd64 ncurses-term all 6.4+20240113-1ubuntu2 [275 kB]
Get:4 http://nl.archive.ubuntu.com/ubuntu noble/main amd64 ssh-import-id all 5.11-0ubuntu2 [10.0 kB]
Fetched 832 kB in 0s (1,823 kB/s)
Preconfiguring packages ...
Selecting previously unselected package openssh-sftp-server.
(Reading database ... 195478 files and directories currently installed.)
Preparing to unpack .../openssh-sftp-server_1k3a9.6p1-3ubuntu13.5_amd64.deb ...
Unpacking openssh-sftp-server (1:9.6p1-3ubuntu13.5) ...
Selecting previously unselected package openssh-server.
Preparing to unpack .../openssh-server_1k3a9.6p1-3ubuntu13.5_amd64.deb ...
Unpacking openssh-server (1:9.6p1-3ubuntu13.5) ...
Selecting previously unselected package ncurses-term.
Preparing to unpack .../ncurses-term_6.4+20240113-1ubuntu2_all.deb ...
Unpacking ncurses-term (6.4+20240113-1ubuntu2) ...
Selecting previously unselected package ssh-import-id.
Preparing to unpack .../ssh-import-id_5.11-0ubuntu2_all.deb ...
Unpacking ssh-import-id (5.11-0ubuntu2) ...
Setting up openssh-sftp-server (1:9.6p1-3ubuntu13.5) ...
Setting up openssh-server (1:9.6p1-3ubuntu13.5) ...
```

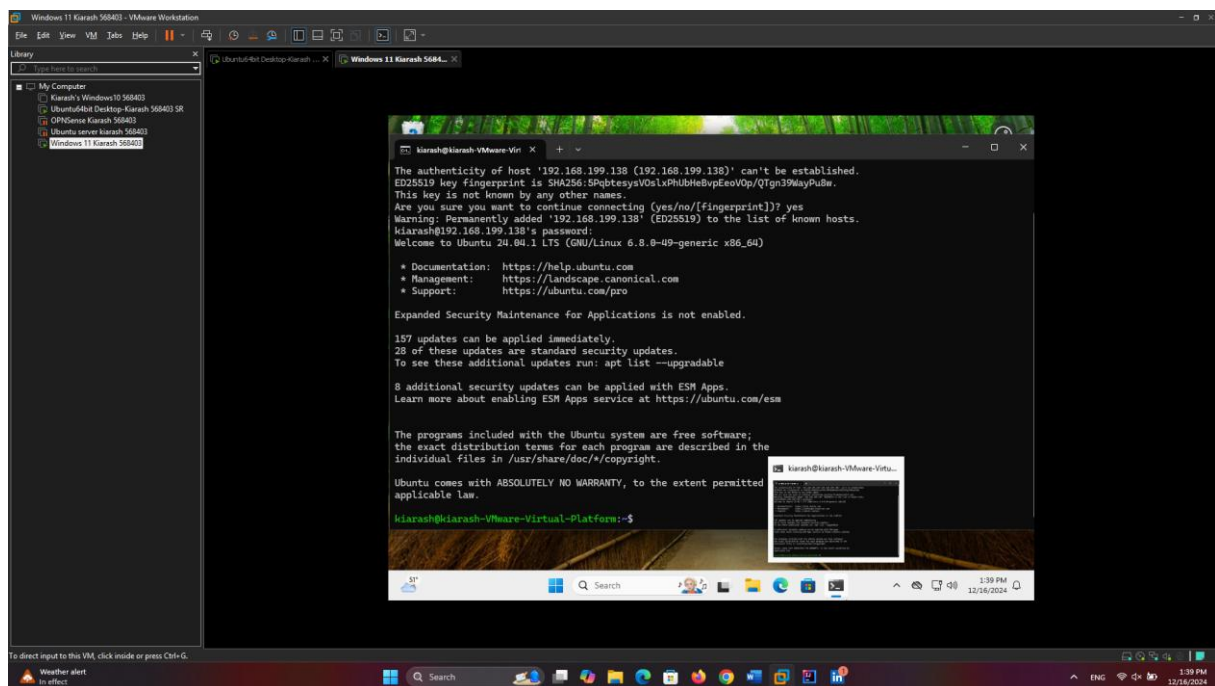
### Screenshot successful SSH command execution:



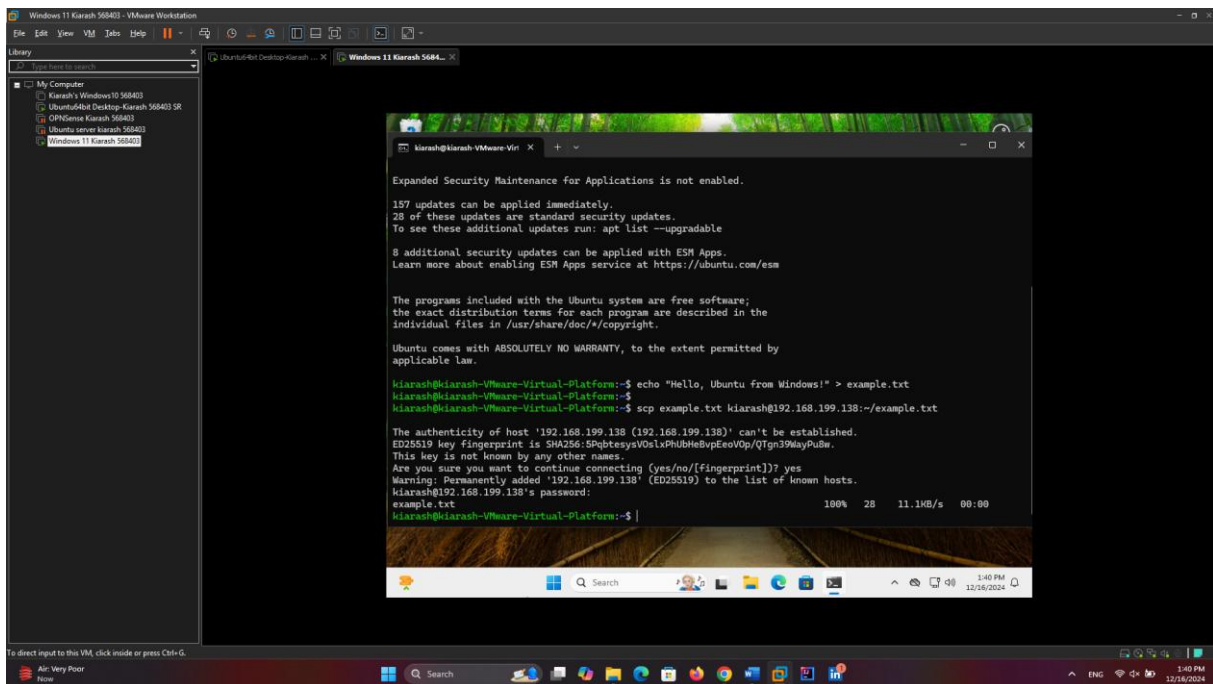
```
Get:1 http://nl.archive.ubuntu.com/ubuntu noble-updates/main amd64 openssh-sftp-server amd64 1:9.6p1-3ubuntu13.5 [37.3 kB]
Get:2 http://nl.archive.ubuntu.com/ubuntu noble-updates/main amd64 openssh-server amd64 1:9.6p1-3ubuntu13.5 [509 kB]
Get:3 http://nl.archive.ubuntu.com/ubuntu noble/main amd64 ncurses-term all 6.4+20240113-1ubuntu2 [275 kB]
Get:4 http://nl.archive.ubuntu.com/ubuntu noble/main amd64 ssh-import-id all 5.11-0ubuntu2 [10.0 kB]
Fetched 832 kB in 0s (1,823 kB/s)
Preconfiguring packages ...
Selecting previously unselected package openssh-sftp-server.
(Reading database ... 195478 files and directories currently installed.)
Preparing to unpack .../openssh-sftp-server_1k3a9.6p1-3ubuntu13.5_amd64.deb ...
Unpacking openssh-sftp-server (1:9.6p1-3ubuntu13.5) ...
Selecting previously unselected package openssh-server.
Preparing to unpack .../openssh-server_1k3a9.6p1-3ubuntu13.5_amd64.deb ...
Unpacking openssh-server (1:9.6p1-3ubuntu13.5) ...
Selecting previously unselected package ncurses-term.
Preparing to unpack .../ncurses-term_6.4+20240113-1ubuntu2_all.deb ...
Unpacking ncurses-term (6.4+20240113-1ubuntu2) ...
Selecting previously unselected package ssh-import-id.
Preparing to unpack .../ssh-import-id_5.11-0ubuntu2_all.deb ...
Unpacking ssh-import-id (5.11-0ubuntu2) ...
Setting up openssh-sftp-server (1:9.6p1-3ubuntu13.5) ...
Setting up openssh-server (1:9.6p1-3ubuntu13.5) ...
Creating config file /etc/ssh/sshd_config with new version
Created symlink /etc/systemd/system/sockets.target.wants/ssh.socket → /usr/lib/s
systemd/system/ssh.socket.
Created symlink /etc/systemd/system/ssh.service.requires/ssh.socket → /usr/lib/s
systemd/system/ssh.socket.
Setting up ssh-import-id (5.11-0ubuntu2) ...
Setting up ncurses-term (6.4+20240113-1ubuntu2) ...
Processing triggers for man-db (2.12.0-4build2) ...
Processing triggers for ufw (0.36-2.4) ...
kiarash@kiarash-VMware-Virtual-Platform: ~$ sudo systemctl start ssh
kiarash@kiarash-VMware-Virtual-Platform: ~$ sudo systemctl enable ssh
Synchronizing state of ssh.service with SysV service script with /usr/lib/systemd/systemd-sysv-install.
Executing: /usr/lib/systemd/systemd-sysv-install enable ssh
Created symlink /etc/systemd/system/ssh.service → /usr/lib/systemd/system/ssh.service.
Created symlink /etc/systemd/system/multi-user.target.wants/ssh.service → /usr/lib/systemd/system/ssh.service.
kiarash@kiarash-VMware-Virtual-Platform: ~$
```



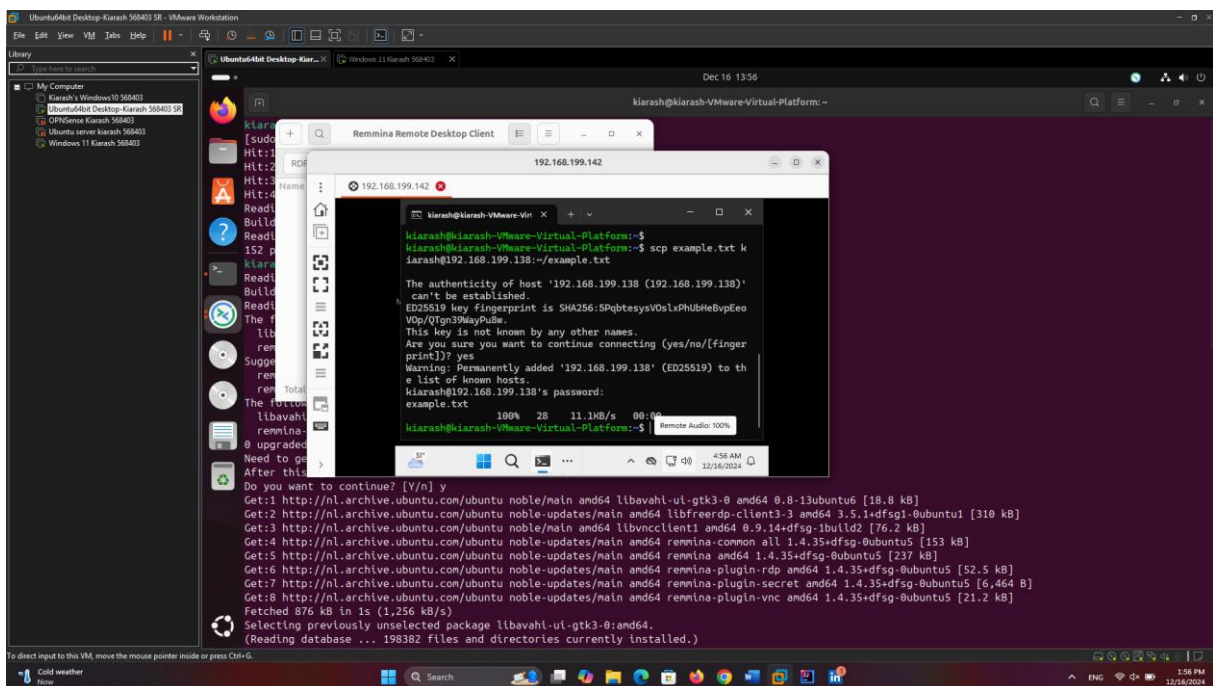
## On Windows 11 VM:



## Screenshot successful execution SCP command:

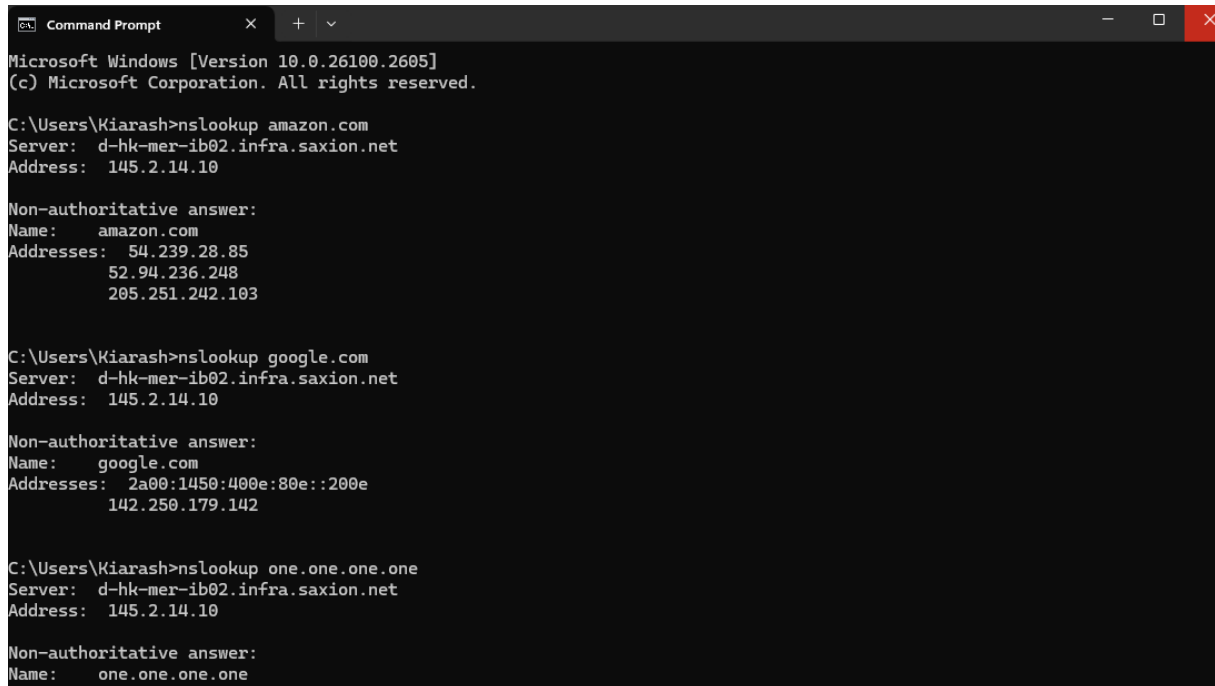


## Screenshot remmina:



## Assignment 6.2: IP addresses websites

### Relevant screenshots nslookup command:



```
Microsoft Windows [Version 10.0.26100.2605]
(c) Microsoft Corporation. All rights reserved.

C:\Users\Kiarash>nslookup amazon.com
Server: d-hk-mer-ib02.infra.saxion.net
Address: 145.2.14.10

Non-authoritative answer:
Name: amazon.com
Addresses: 54.239.28.85
          52.94.236.248
          205.251.242.103

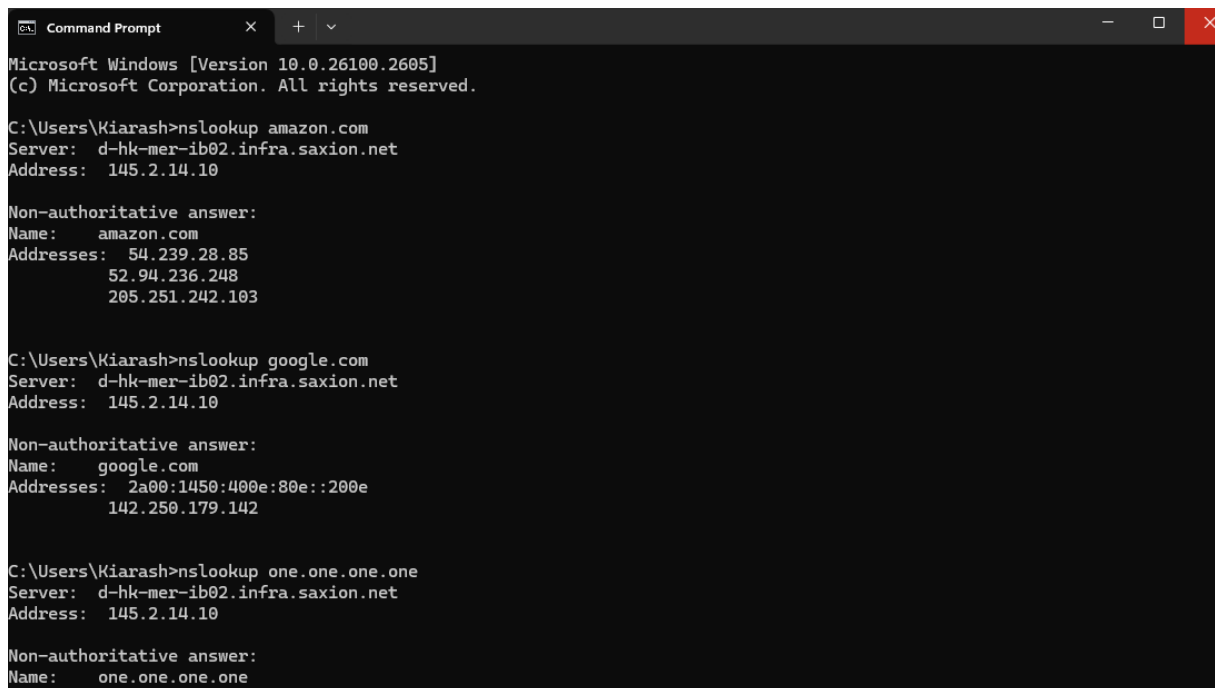
C:\Users\Kiarash>nslookup google.com
Server: d-hk-mer-ib02.infra.saxion.net
Address: 145.2.14.10

Non-authoritative answer:
Name: google.com
Addresses: 2a00:1450:400e:80e::200e
          142.250.179.142

C:\Users\Kiarash>nslookup one.one.one.one
Server: d-hk-mer-ib02.infra.saxion.net
Address: 145.2.14.10

Non-authoritative answer:
Name: one.one.one.one
```

### Screenshot website visit via IP address:



```
Microsoft Windows [Version 10.0.26100.2605]
(c) Microsoft Corporation. All rights reserved.

C:\Users\Kiarash>nslookup amazon.com
Server: d-hk-mer-ib02.infra.saxion.net
Address: 145.2.14.10

Non-authoritative answer:
Name: amazon.com
Addresses: 54.239.28.85
          52.94.236.248
          205.251.242.103

C:\Users\Kiarash>nslookup google.com
Server: d-hk-mer-ib02.infra.saxion.net
Address: 145.2.14.10

Non-authoritative answer:
Name: google.com
Addresses: 2a00:1450:400e:80e::200e
          142.250.179.142

C:\Users\Kiarash>nslookup one.one.one.one
Server: d-hk-mer-ib02.infra.saxion.net
Address: 145.2.14.10

Non-authoritative answer:
Name: one.one.one.one
```

### Assignment 6.3: subnetting

How many IP addresses are in this network configuration 192.168.110.128/25?

+ 128 IP addresses ( $2^7 (32-25) = 2^7 = 128$ )

What is the usable IP range to hand out to the connected computers?

+ Is 126 (128-2). Exclude the **network address** (first address in the range) and the **broadcast address** (last address in the range).

Check your two previous answers with this calculator:

<https://www.calculator.net/ip-subnet-calculator.html>

**Explain the above calculation in your own words:**

**1- Total IP Addresses:**

The subnet 192.168.110.128/25 means there are a total of **128 IP addresses** in this network. This includes all the addresses from 192.168.110.128 to 192.168.110.255.

**2- Usable IP Addresses:**

Out of these 128 addresses, the first one (192.168.110.128) is the **network address**, and the last one (192.168.110.255) is the **broadcast address**. These two addresses cannot be assigned to devices.

That leaves **126 usable addresses**, which range from 192.168.110.129 to 192.168.110.254.

**3- Subnet Mask:**

The subnet mask for /25 is 255.255.255.128. This means the first 25 bits of the IP are fixed for the network, while the remaining 7 bits are used for devices (hosts) in the network.

**4- How the Calculator Confirms This:**

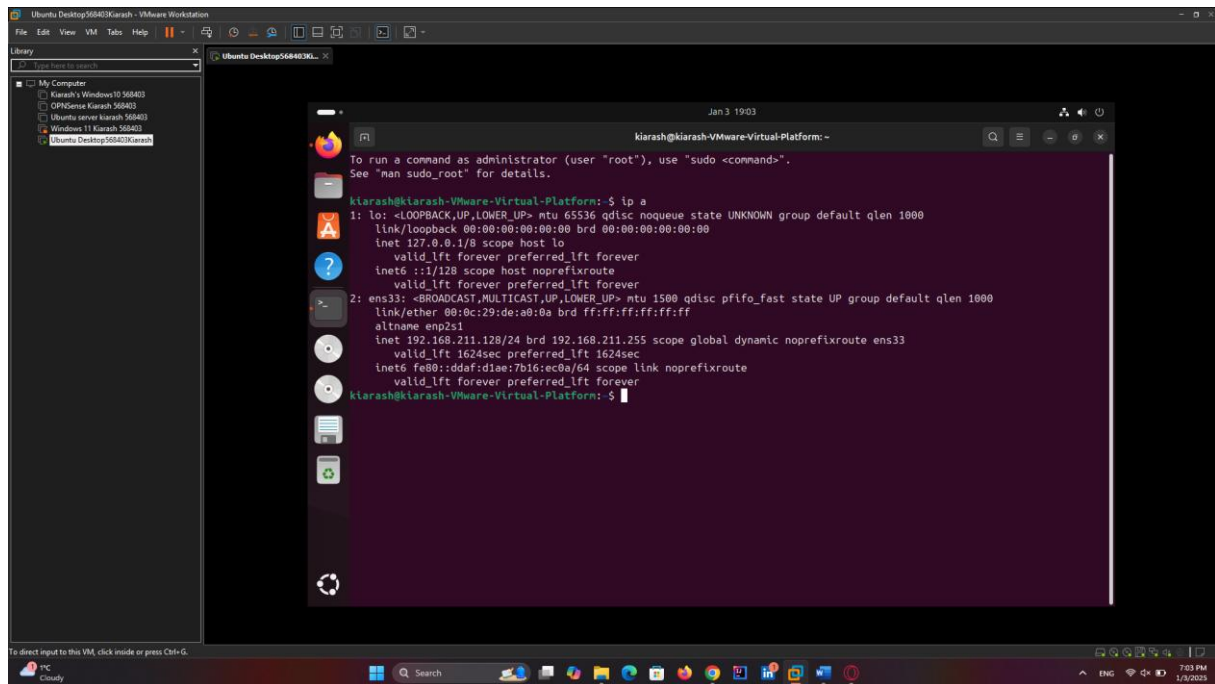
The subnet calculator shows:

- Total IPs: 128
- Usable range: 192.168.110.129 to 192.168.110.254
- Usable hosts: 126
- Network address: 192.168.110.128
- Broadcast address: 192.168.110.255

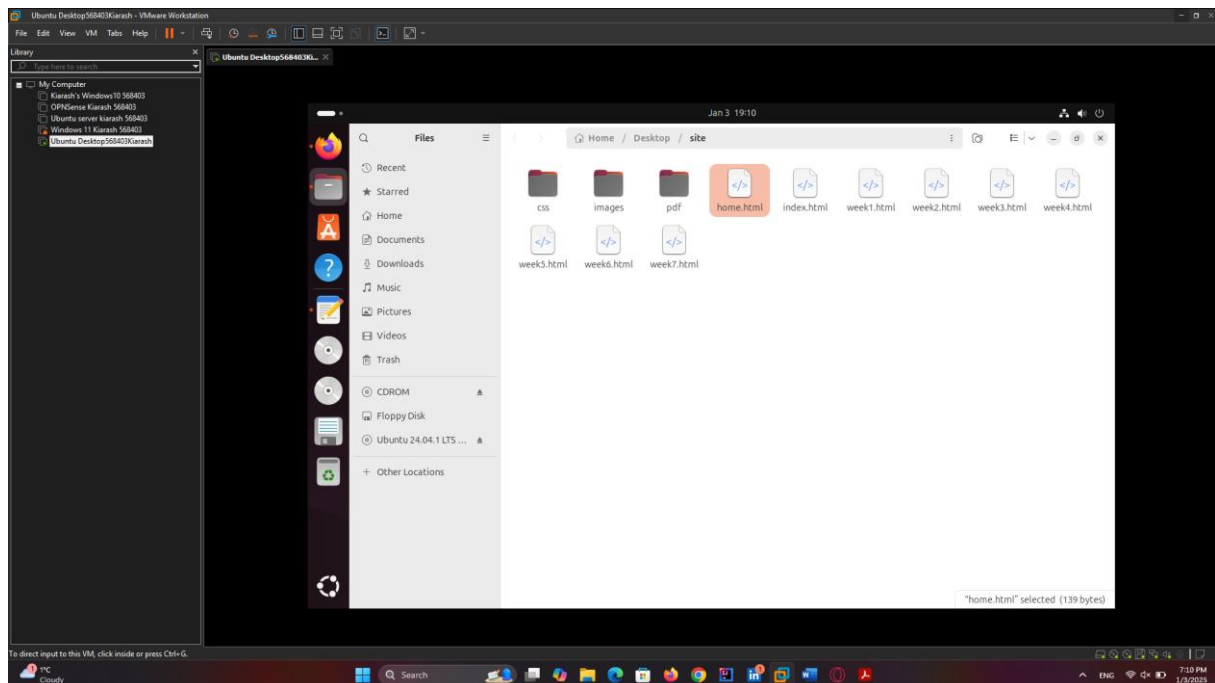


## Assignment 6.4: HTML

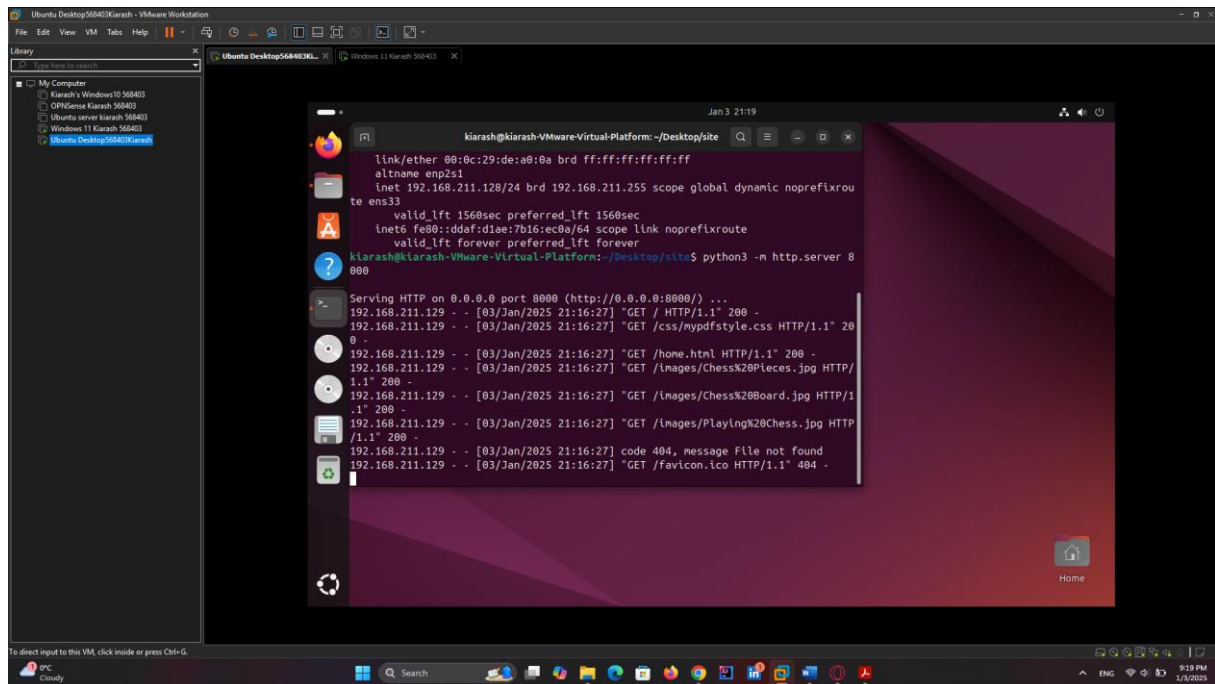
### Screenshot IP address Ubuntu VM:



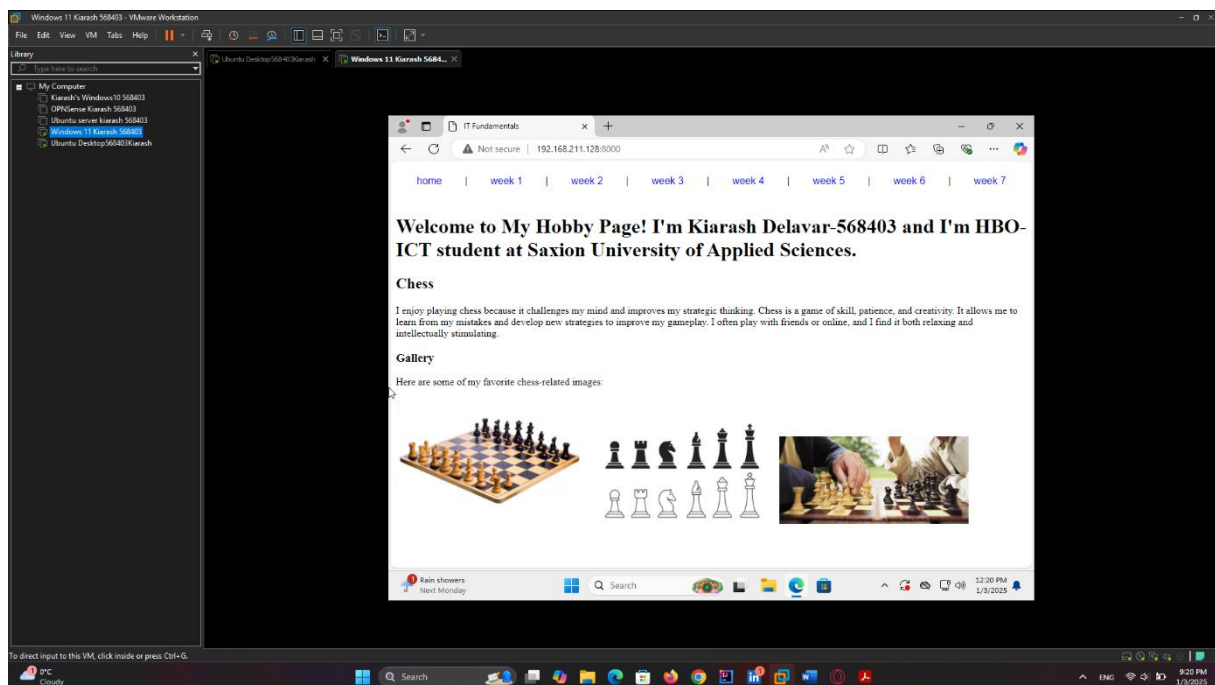
### Screenshot of Site directory contents:



## Screenshot python3 webserver command:



## Screenshot web browser visits your site: (Windows 11 VM-Microsoft Edge)



## Bonus point assignment – week 6

Remember that bitwise java application you've made in week 2? Expand that application so that you can also calculate a network segment as explained in the PowerPoint slides of week 6. Use the bitwise & AND operator. You need to be able to input two Strings. An IP address and a subnet.

IP: 192.168.1.100 and subnet: 255.255.255.224 for /27

Example: 192.168.1.100/27

Calculate the network segment

IP Address: 11000000.10101000.00000001.01100100

Subnet Mask: 11111111.11111111.11111111.11100000

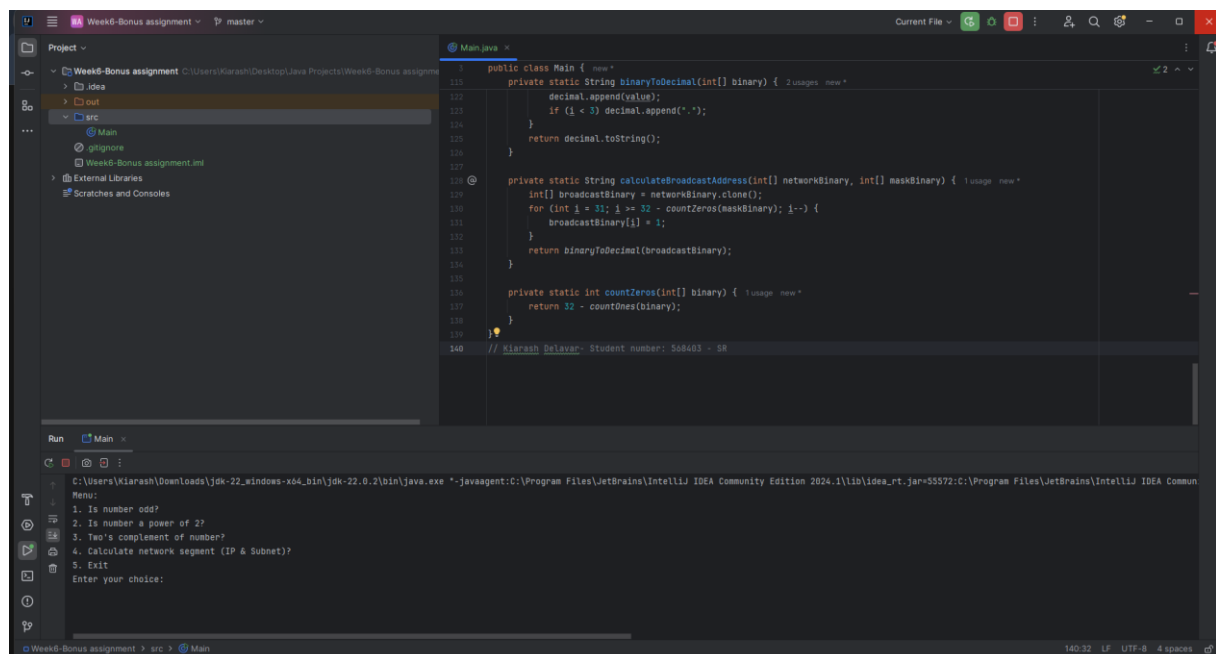
-----  
Network Addr: 11000000.10101000.00000001.01100000

This gives 192.168.1.96 in decimal as the network address.

For a /27 subnet, each segment (or subnet) has 32 IP addresses ( $2^5$ ).

The range of this network segment is from 192.168.1.96 to 192.168.1.127.

Paste source code here, with a screenshot of a working application:



```
public class Main {
    private static String binaryToDecimal(int[] binary) {
        decimal.append(value);
        if (i < 3) decimal.append(".");
    }
    return decimal.toString();
}

private static String calculateBroadcastAddress(int[] networkBinary, int[] maskBinary) {
    int[] broadcastBinary = networkBinary.clone();
    for (int i = 31; i >= 32 - countZeros(maskBinary); i--) {
        broadcastBinary[i] = 1;
    }
    return binaryToDecimal(broadcastBinary);
}

private static int countZeros(int[] binary) {
    return 32 - countOnes(binary);
}
}

// Kiaraish Delaver- Student number: 508405 - SR
```

Run Main

C:\Users\Kiarash\Downloads\jdk-22\_windows-x64\_bin\jdk-22.0.2\bin\java.exe -javaagent:C:\Program Files\JetBrains\IntelliJ IDEA Community Edition 2024.1\lib\idea\_rt.jar=55572:C:\Program Files\JetBrains\IntelliJ IDEA Commun

Menu:

1. Is number odd?
2. Is number a power of 2?
3. Two's complement of number?
4. Calculate network segment (IP & Subnet)?
5. Exit

Enter your choice:

Please See the next page!



```
3. Two's complement of number?
4. Calculate network segment (IP & Subnet)?
5. Exit
Enter your choice: 4
Enter IP Address (e.g., 192.168.1.100): 192.168.1.102
Enter Subnet Mask (e.g., 255.255.255.224 or /27): /27
Network Address: 192.168.1.96
Total IPs in Subnet: 32
IP Range: 192.168.1.96 to 192.168.1.127
```

Source code here:

```
import java.util.Scanner;

public class Main {
    public static void main(String[] args) {
        Scanner scanner = new Scanner(System.in);
        int choice;
        do {
            System.out.println("Menu:");
            System.out.println("1. Is number odd?");
            System.out.println("2. Is number a power of 2?");
            System.out.println("3. Two's complement of number?");
            System.out.println("4. Calculate network segment (IP & Subnet)?");
            System.out.println("5. Exit");
            System.out.print("Enter your choice: ");
            choice = scanner.nextInt();

            switch (choice) {
                case 1:
                    System.out.print("Enter a number: ");
                    int numOdd = scanner.nextInt();
                    System.out.println("Is the number odd? " + isOdd(numOdd));
                    break;
                case 2:
                    System.out.print("Enter a number: ");
                    int numPower = scanner.nextInt();
                    System.out.println("Is the number a power of 2? " + isPowerOfTwo(numPower));
                    break;
                case 3:
                    System.out.print("Enter a number: ");
                    int numTwosComplement = scanner.nextInt();
                    System.out.println("Two's complement of the number: " +
twosComplement(numTwosComplement));
                    break;
                case 4:
```

```

        scanner.nextLine(); // Consume the newline character
        System.out.print("Enter IP Address (e.g., 192.168.1.100): ");
        String ipAddress = scanner.nextLine();
        System.out.print("Enter Subnet Mask (e.g., 255.255.255.224 or /27): ");
        String subnetMask = scanner.nextLine();
        calculateNetworkSegment(ipAddress, subnetMask);
        break;
    case 5:
        System.out.println("Exiting...");
        break;
    default:
        System.out.println("Invalid choice. Please try again.");
    }
    System.out.println();
} while (choice != 5);

scanner.close();
}

private static boolean isOdd(int number) {
    return (number & 1) == 1;
}

private static boolean isPowerOfTwo(int number) {
    return number > 0 && (number & (number - 1)) == 0;
}

private static int twosComplement(int number) {
    return ~number + 1;
}

private static void calculateNetworkSegment(String ipAddress, String subnetMask) {
    int[] ipBinary = convertToBinary(ipAddress);
    int[] maskBinary = subnetMask.startsWith("/")
        ? cidrToBinary(subnetMask)
        : convertToBinary(subnetMask);

    int[] networkAddressBinary = new int[32];
    for (int i = 0; i < 32; i++) {
        networkAddressBinary[i] = ipBinary[i] & maskBinary[i];
    }

    String networkAddress = binaryToDecimal(networkAddressBinary);

    int totalIPs = 1 << (32 - countOnes(maskBinary));
    String broadcastAddress = calculateBroadcastAddress(networkAddressBinary, maskBinary);

    System.out.println("Network Address: " + networkAddress);
}

```

```

        System.out.println("Total IPs in Subnet: " + totalIPs);
        System.out.println("IP Range: " + networkAddress + " to " + broadcastAddress);
    }

    private static int[] convertToBinary(String ip) {
        String[] parts = ip.split("\\.");
        int[] binary = new int[32];
        for (int i = 0; i < 4; i++) {
            int value = Integer.parseInt(parts[i]);
            for (int j = 0; j < 8; j++) {
                binary[i * 8 + (7 - j)] = (value >> j) & 1;
            }
        }
        return binary;
    }

    private static int[] cidrToBinary(String cidr) {
        int prefixLength = Integer.parseInt(cidr.replace("/", ""));
        int[] binary = new int[32];
        for (int i = 0; i < prefixLength; i++) {
            binary[i] = 1;
        }
        return binary;
    }

    private static int countOnes(int[] binary) {
        int count = 0;
        for (int bit : binary) {
            if (bit == 1) count++;
        }
        return count;
    }

    private static String binaryToDecimal(int[] binary) {
        StringBuilder decimal = new StringBuilder();
        for (int i = 0; i < 4; i++) {
            int value = 0;
            for (int j = 0; j < 8; j++) {
                value += binary[i * 8 + j] << (7 - j);
            }
            decimal.append(value);
            if (i < 3) decimal.append(".");
        }
        return decimal.toString();
    }

    private static String calculateBroadcastAddress(int[] networkBinary, int[] maskBinary) {
        int[] broadcastBinary = networkBinary.clone();

```

```
    for (int i = 31; i >= 32 - countZeros(maskBinary); i--) {  
        broadcastBinary[i] = 1;  
    }  
    return binaryToDecimal(broadcastBinary);  
}  
  
private static int countZeros(int[] binary) {  
    return 32 - countOnes(binary);  
}  
}
```

Ready? Save this file and export it as a pdf file with the name: [week6.pdf](#)